Space Weather Technical Forecast

Issued on Wednesday, 23 February 2022 at 12:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight chance throughout of M-class flares. Increasing Chance of Active fluence levels, mainly from day 2 (24 Feb) onward.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Very Low over the past 24 hours, with no significant flares. There are currently three sunspot regions on the Earth-facing disc. AR2953 in the northwest has shown a implication in its structure. AR2954 in the northeast appears to be a mature but stable region. Lying just to the southeast is AR2955, classified as Cho/Beta and may be showing signs of increased complexity with some spots in its trailing region.

No Earth-directed CMEs were observed in the available imagery during the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, has been elevated at times through the period, due to connection to the High Speed Stream (HSS) from positive coronal hole CH56/+ which is now close to the western limb. The solar wind is currently slightly elevated having declined to just below 500 km/s. The density has been average or slightly above average. The total magnetic field strength (IMF) Bt, has been weak (<8 nT), with the Bz fluctuating between -nT and +6nT. The phi angle has been mostly positive (away from the Sun). Resultant geomagnetic activity was Quiet (Kp 0-2).

Energetic Particles / Solar Radiation: The high energy proton flux (10MeV) measured at GOES 16 was at background levels. The high energy electron flux (greater than 2MeV) has been at normal background to Moderate levels, reaching a peak of 553 pfu at 22/1730 UTC. The corresponding 24-hour integrated electron fluence is well below the Active (1e8 integrated pfu) threshold, and has recently shown a flat profile, having increased at the start of the period. The 23/0001 UTC observation was 1.28e7 pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to be Very Low or Low, but there is a slight chance of rising to Moderate levels through the 4 days due to the potential for flaring from AR2955 in the northeast.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs in the forecast. Earth is experiencing the high speed stream from CH56/+ with a mostly gradual easing expected to continue, although the HSS from CH57 may give a slight boost during day 2 (24 Feb). A glancing low from CME may also affect Earth during day 1 (24 Feb) with low confidence. Geomagnetic activity is expected to be mostly Quiet, with a chance (20-50%) of an Active interval, most likely on day 1 or 2 (Feb 24 or 25).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to remain at background levels. The high energy (greater than 2 MeV) electron flux is

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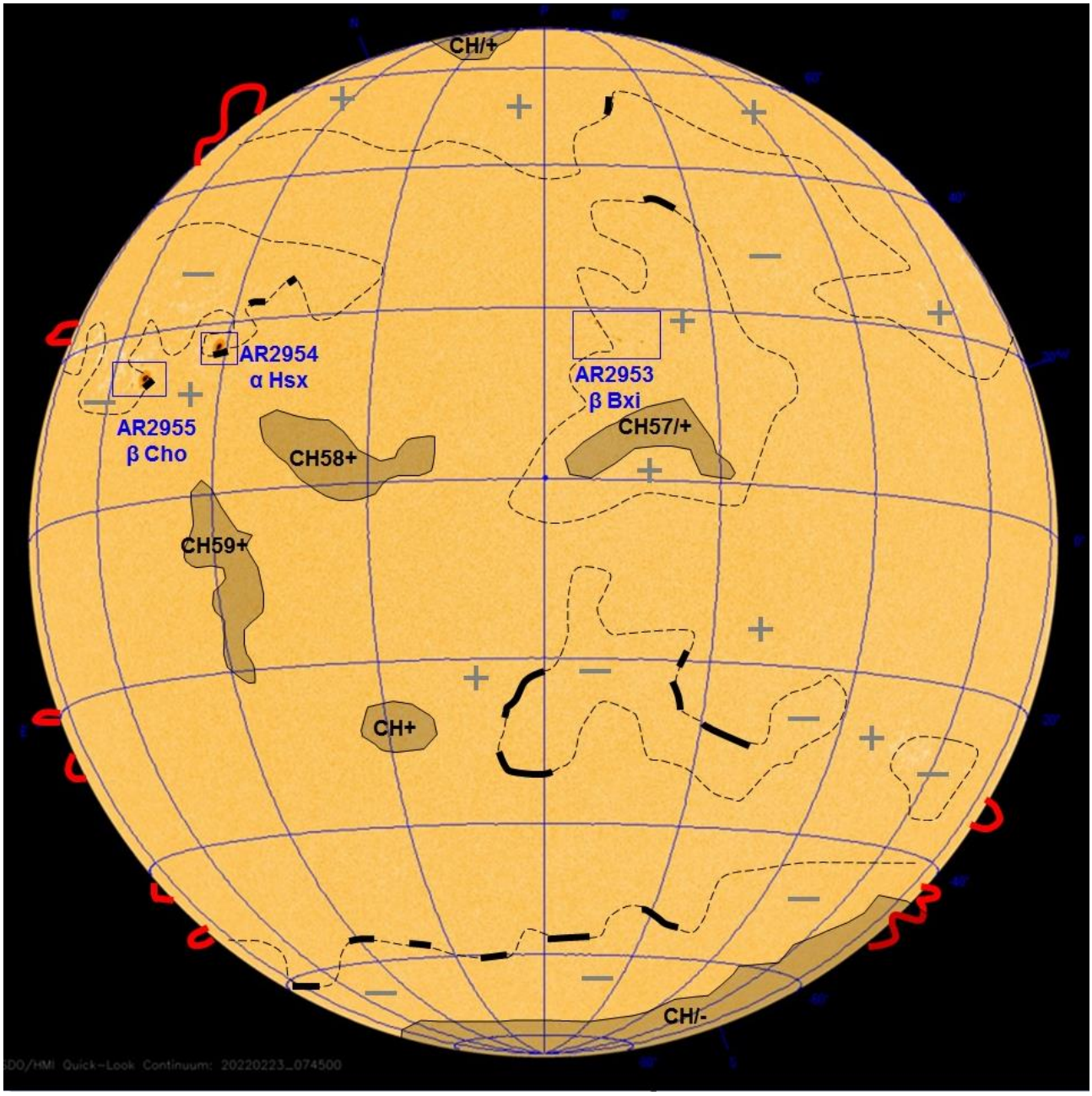
at normal background to Moderate levels, but will probably trend upwards with to peak at High (greater than 1000 pfu) levels around the diurnal maximum by day 2 (24 Feb). The associated fluence is also likely to rise, with a chance of exceeding the Active threshold (1e8 integrated pfu), most likely on day 3 or 4 (25-26 Feb).

Figure 1. Solar Analysis Valid 0800 UTC, 23 February 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

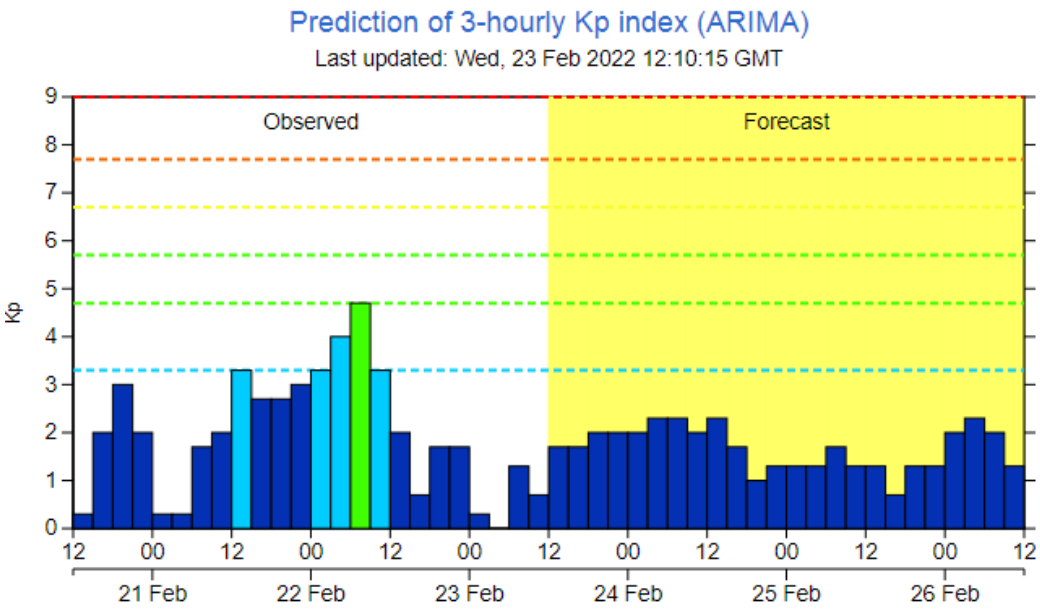
There are no Earth-directed CMEs in the forecast, although there is a slight chance of weak CME effects on days 1 or 2 (23rd/24th) from a glancing blow from a filament lift off that occurred on the 19th Feb (Low confidence).
Solar wind speeds are currently slightly elevated, due to the high speed stream from CH56/+. They are expected to continue declining towards ambient levels through the remainder of the period as the effects of the coronal hole wane. A minor HSS from CH57 is anticipated to impact Earth on day 2 (24 Feb) or perhaps early on day 3 (25 Feb) with a slight increase in solar winds to around 500 km/s. Geomagnetic activity is likely to be mostly Quiet with a chance (20-50%) of an Active interval, this most likely on day 1 or 2 (24 or 25 Feb).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	1	1	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS Prediction of 3-Hourly Kp Index (ARIMA).



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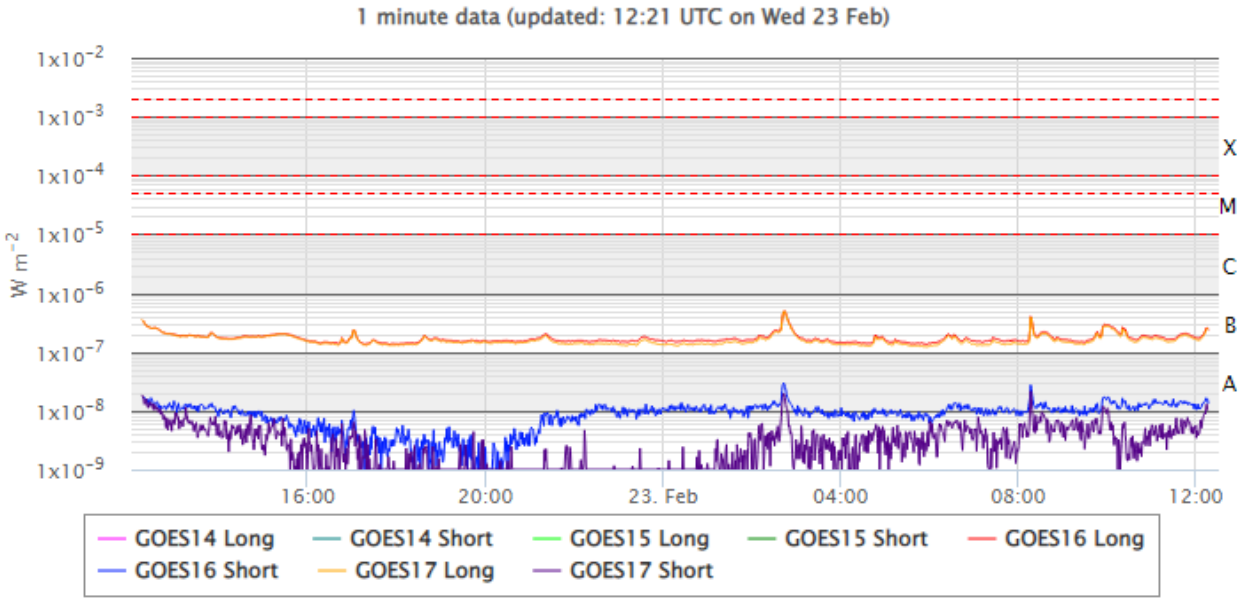
Radio Blackouts - X-Ray Flares:

There are currently three sunspot groups on the visible disc. AR2954 appears to be a mature but stable Hsx/Alpha region and is in the southeast quadrant of the visible disc. AR2955 to the SE was the region thought to have been the source of an energetic flare and CME on the far side on the 15th. It has already produced a long duration C3.1 flare on the 21st but was quiet through the 22nd, this region is currently classified as Cho/Beta. AR2953, classified as a Bxi/Beta region remains stable and inactive.

Solar activity has been Very Low over the past 24 hours with no significant flares. It is likely to remain Low through the forecast period but there is a slight chance (5--10%) of it increasing to Moderate if any M-class flares are emitted from AR2955.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: GOES X-Ray flux plot showing a few minor B-class flares over the past 24 hours.



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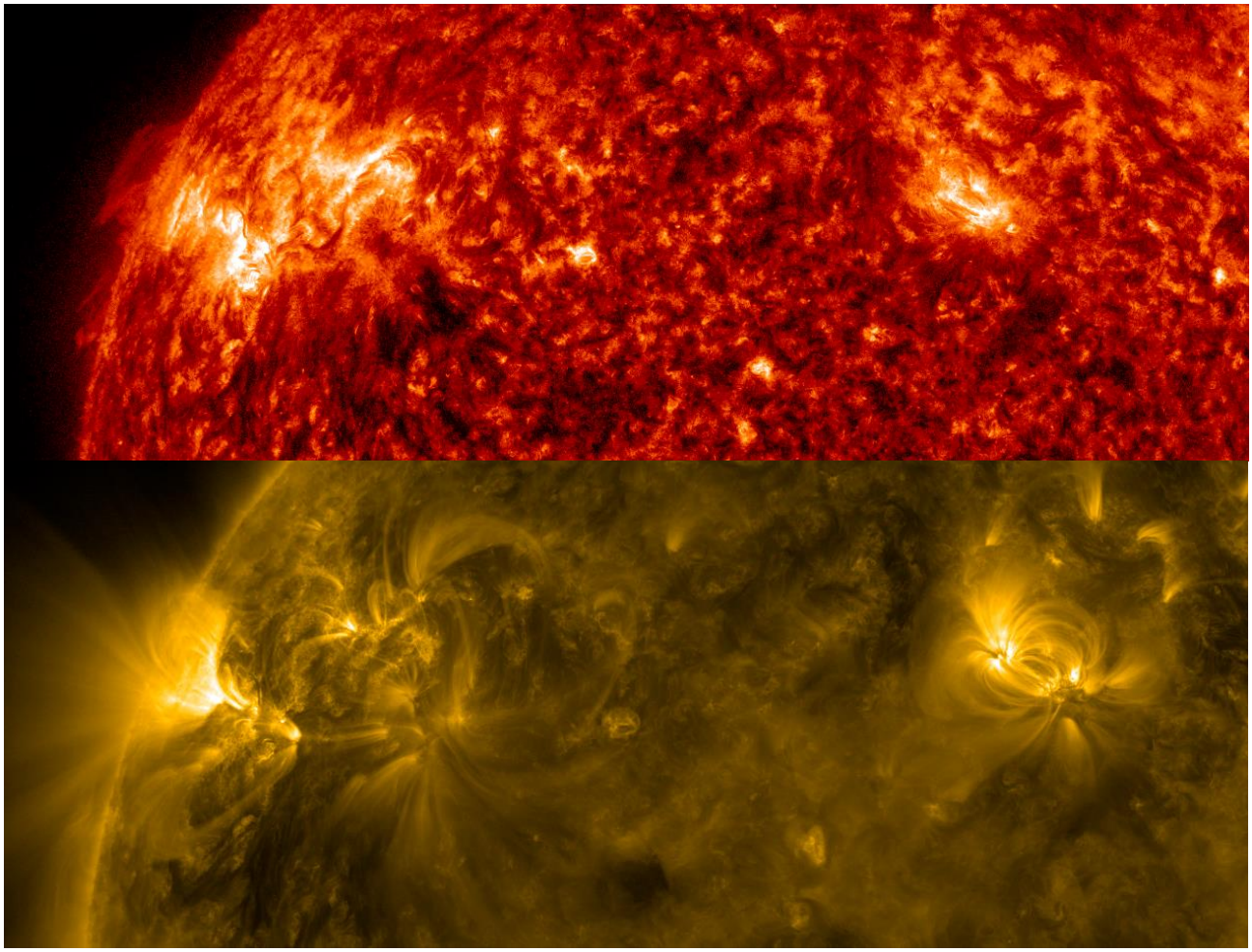
Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (10MeV) measured at GOES 16 is at background levels. Unless we see further significant flares it is likely to remain unchanged.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	1	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: SDO-aia 304 and 171 (lower) satellite imagery showing the structure of the 3 sunspot regions on the visible disc.



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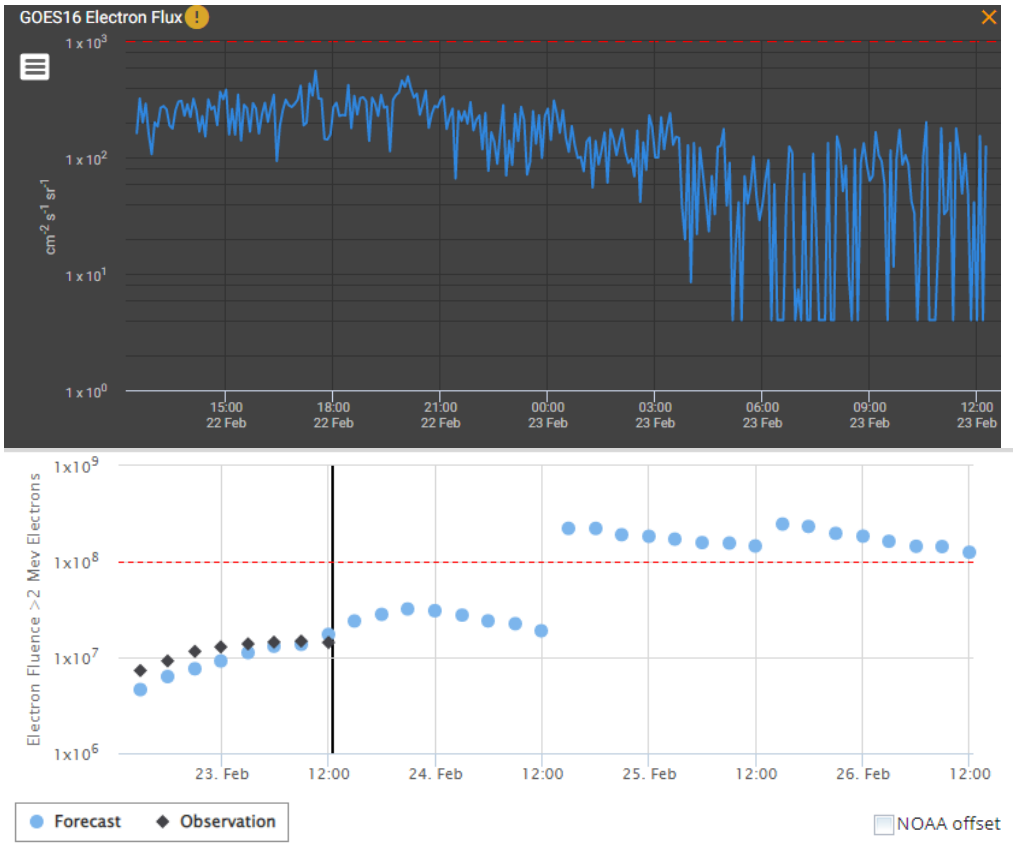
High Energy Electrons Event (≥ 2MeV):
High energy electron flux (greater than 2 MeV) as observed by GOES-16 at GEO is at normal background to moderate levels. Electron flux is expected to rise in the coming days, probably peaking during the diurnal maximum at High levels (greater than 1000 pfu) from day 2 (24th Feb) onwards.

The associated 24 hour Fluence is currently below the Active threshold and displays a mostly rising trend. There is an increasing chance of Fluence levels becoming Active (>1e8 integrated pfu), with a chance of exceeding this threshold by day 3 or 4 (25-26 Feb). Met Office REFM output is showing an overall rising trend in electron fluence over the coming days and can be used as a rough guide for likely fluence values.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	20	40	60	70
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	5

Figure 5: High energy electron flux and Met Office REFM output indicating an overall rising trend in activity.



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